

RADIO TEST REPORT

No. 412825R1**EQUIPMENT UNDER TEST**

Equipment: Medical device
Type / model: NOAHlink
Manufacturer: GN Otometrics A/S
Tested by request of: GN Otometrics A/S

SUMMARY

The equipment complies with the requirements of the following standards:

FCC, Part 15, Subpart B (2003) and Subpart C (2003);
RSS-210, Issue 5 (November 2001)

Industry Canada listed test facility No. IC 3481



Date of issue: March 15, 2005

Tested by:

Vladimir Bazhanov

Approved by:

Kenth Skoglund

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Intertek Semko AB

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1. CLIENT INFORMATION

The EUT has been tested by request of

Company: GN Otometrics A/S
 Dybendalsvaenget 2
 DK-2630 Taastrup
 Denmark
 Name of contact: Mr. Per Pape Thomsen

2. EQUIPMENT UNDER TEST (EUT)

2.1 Identification of the EUT according to the manufacturer/client declaration

Equipment: Medical device
 Type/Model: NOAHlink
 Brand name: -
 Serial number: -
 FCC ID Number: -
 Manufacturer: GN Otometrics A/S
 Rating/Supplying voltage: 1,3 V DC
 Rating RF output power: Power class 2
 Antenna gain: Not available
 External antenna connector: NO
 Operating temperature range: 5 to 45 °C
 Frequency range: 2400 – 2483,5 MHz
 Number of channels: 79
 Modulation characteristics: GFSK
 Stand by mode supported: Yes

2.2 Additional hardware information about the EUT

The EUT consists of the following unit:

Unit	Type and version	Serial number
Medical device	NOAHlink	-



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2.3 Additional software information about the EUT

During the tests the EUT supported the following software:

Software	Version	Comment
Kernel	1.4	-
BT Stack	1.2A	-

2.4 Peripheral equipment

Peripheral equipment is defined as equipment needed for correct operation of the EUT during the tests, but not included as a part of the testing and evaluation of the EUT.

Equipment	Manufacturer / Type	Serial number
Bluetooth starter kit	Ericsson AB / ROK 101 008/21 P3G	106002538 8001001 01W06 S61
Laptop PC (SW: EBDK v2.0.1.5)	IBM ThinkPad / 2645450	55223TF

2.5 Modifications during the tests

The following hardware changes have been performed to reduce spurious emissions in the frequency range 30 – 1000 MHz.

The NOAHlink main board PCB (2-11-22700):

- PCB Layer stack-up was changed so that the Ground and DSP Power Supply plane layers were brought closer together. This was done in order to increase the capacitance between Ground and Power Supply planes (improved decoupling).
- The areas of the Ground and DSP Power Supply planes layers were increased. This was done to increase the capacitance between Ground and Power Supply planes (improved decoupling).
- The PCB traces from the Ground and Power supply terminals, on the DSP, to the planes, were optimized to reduce the series impedance at high frequencies.
- The PCB revision number was changed to /03 (2-11-22700/03).

The BOM of NOAHlink main board (8-14-86100/05):

- Two decoupling capacitors were changed to a special low inductance type of capacitors.

No other modifications have been made during the tests.



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3. TEST SPECIFICATIONS

3.1 Standards

FCC 47 CFR part 15 (2003) Subpart B – Unintentional radiators
FCC 47 CFR part 15 (2003) Subpart C – Intentional Radiators: §15.249 Operation within the bands 902-928 MHz, 2400 – 2483.5 MHz, 5725 – 5875 MHz, and 24.0 – 24.25 GHz.

Measurements methods according to ANSI C63.4-2003

RSS-210, Issue 5 (November 2001): Low Power Licence-Exempt Radio communication Devices.

3.2 Additions, deviations and exclusions from standards

Before testing the lab. work has been performed in order to investigate the influence of cables attached to the EUT on the emissions characteristics. It has been found out that radiated emissions of the EUT do not noticeably change with and without the attached cables. Thus for practical reasons further tests were performed without cables.

Similarly radiated emissions were estimated with the EUT positioned in each of its 3 orthogonal axes and from different positions of the EUT on the turntable the most critical one has been found. Then the tests were performed in this worst case configuration.

No other additions, deviations or exclusions have been made from standards.

3.3 Test set-up

Measurement set-up for the out-of-band spurious emissions test is described in Section 7.4.

3.4 Operating environment

If not additionally specified, the tests were performed under the following environmental conditions:

Air temperature:	23 °C
Relative humidity:	26 %



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4. TEST SUMMARY

The results in this report apply only to the sample tested.

FCC reference	RSS-210 reference	Test	Result	Note
15.249	6.2.2(o)(a3)	Peak output power	Pass	
15.249	6.2.2(o)	Band edge compliance	Pass	
15.249	6.2.2(o)(e1)	Out of band spurious emissions, radiated	Pass	1
15.249	6.2.2(o)(e1)	Out of band spurious emissions, conducted	NA	
15B	6.2.2(o)(e1)	Out of band spurious emissions, radiated	Pass	
15B	6.2.2(o)	Conducted emission at AC port	NA	

NA = Not Applicable

Note:

1. The measured result is below the upper limit, but by a margin less than half of the uncertainty interval; it is therefore not possible to state compliance based on the 95% level of confidence. However, the result indicates that compliance is more probable than non-compliance.



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5. PEAK OUTPUT POWER

5.1. Test set-up

See Section 7.4.

5.2. Test protocol

Date of test: October 28, 2004

Channel (MHz)	Peak Output Power (dB μ V/m)	Limit value (dB μ V/m)
2402	78,4	94
2441	77,7	
2480	74,7	



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6. BAND EDGE COMPLIANCE

6.1. Test set-up

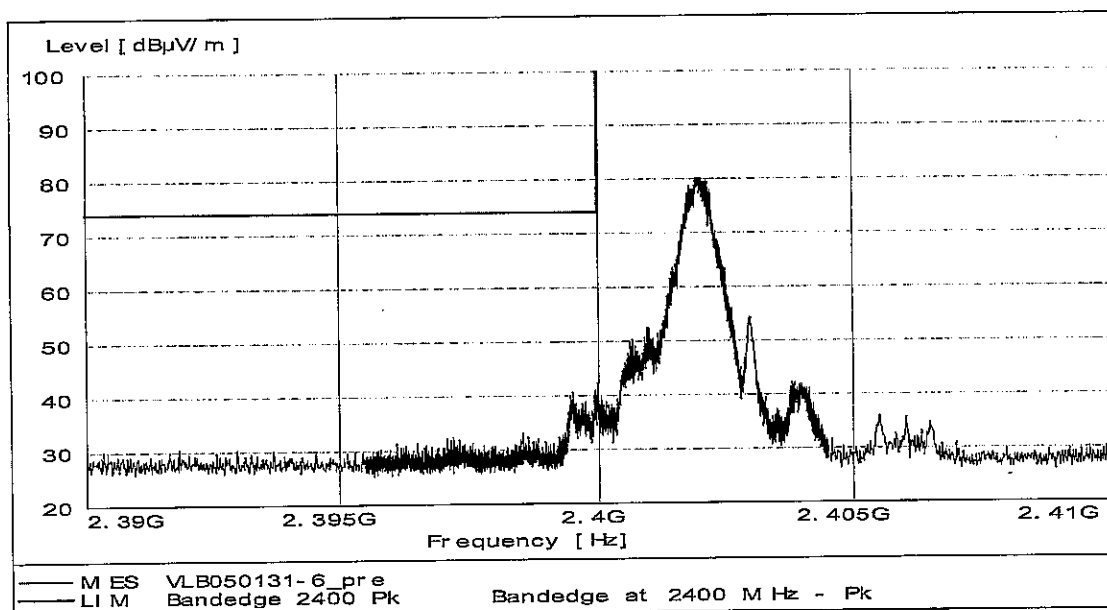
See section 7.4.

6.2. Test protocol

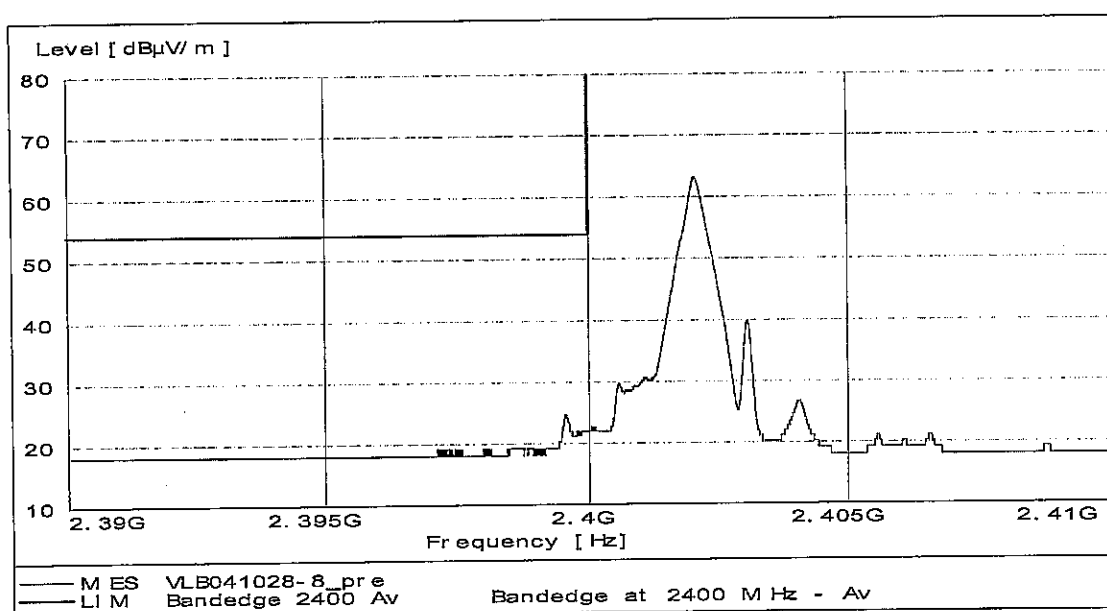
Date of test: October 28, 2004 and January 31, 2005

Band edge compliance at 2400 MHz

Sweep with peak detector



Sweep with average detector



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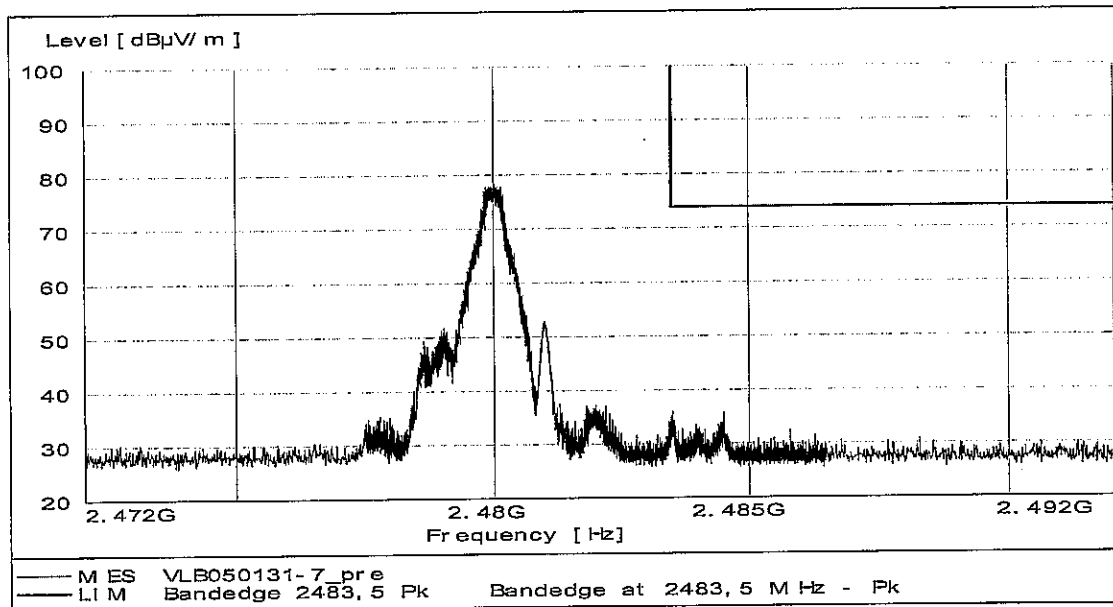
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Telephone +46 8 750 00 00, Fax +46 8 750 60 30, www.sweden.intertek-etlsemko.com

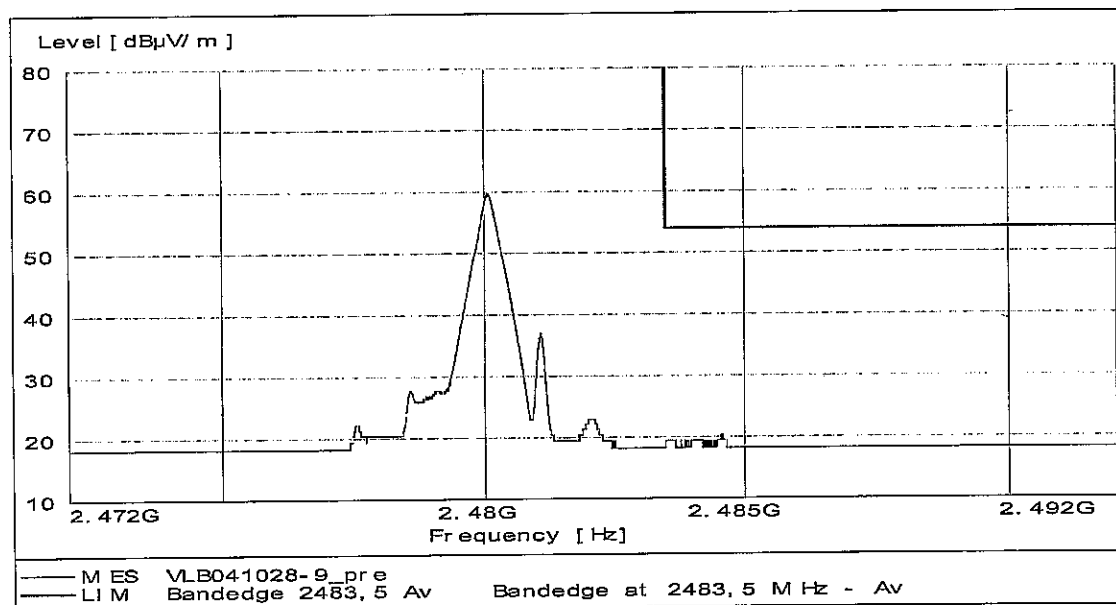
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Band edge compliance at 2483,5 MHz

Sweep with peak detector



Sweep with average detector



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7. RADIATED SPURIOUS EMISSIONS

7.1 Operating environment

Temperature: 23 °C (10 – 40 °C)
 Relative Humidity: 26 % (10 - 90 %)

7.2 Measurement uncertainty

Radiated disturbance electric field intensity, 30 – 1000 MHz: $\pm 4,6$ dB
 Radiated disturbance electric field intensity, 1000 – 18000 MHz: $\pm 6,0$ dB

The measurement uncertainty describes the overall uncertainty of the given measured value during operation of the EUT.

Measurement uncertainty is calculated in accordance with EA-4/02-1997.
 The measurement uncertainty is given with a confidence of 95%.

7.3 Test equipment

Equipment	Manufacturer	Type	SEMKO No.
<i>Test site: Semi-anechoic shielded chamber, 10 x 20 x 8,5 m (W x L x H)</i>			30300
Software:	Rohde & Schwarz	ES-K1, V1.60	
Measurement receiver:	Rohde & Schwarz	ESAI	2973/2974
Antenna amplifier:	SEMKO		7992/7993
Antenna, bilog:	Chase	CBL6111A	8578
<i>Test site: Bluetooth anechoic shielded chamber, 3,7 x 7,0 x 2,4 m (W x L x H)</i>			12285
Software:	Rohde & Schwarz	ES-K1, V1.70	
Signal analyser:	Rohde & Schwarz	FSIQ 40	40023
Preamplifier:	MITEQ	AFS6/AFS44	12335
Antennas:			
Double Ridge Guide Horn	EMCO	3115	4936
Horn antenna	EMCO	3160-08	30099
Horn antenna	EMCO	3160-09	30101



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7.4 Measurement set-up

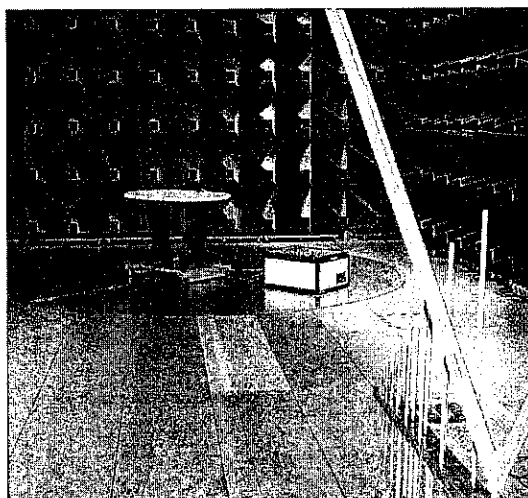
Test site: Semi-anechoic shielded chamber (30 – 1000 MHz)

The radiated disturbance electric field intensity was measured in a semi-anechoic chamber at a distance of 10 m and the EUT was placed on a non-metallic table, 0,8 m above the reference ground plane. The specified test mode was enabled. Test set-up photos are given below.

An overview sweep with peak detection of the electric field intensity was performed with the measurement receiver in max-hold and with the antenna placed 1,5 m, 2,5 m and 3,5 m above the floor. The polarisation was horizontal and vertical. The measurements were repeated with the EUT rotated in 90-degree steps.

At the frequencies where high disturbance levels were found a search for max disturbance level was performed. With the EUT and antenna in the worst-case configuration new measurements with quasi-peak detector were carried out.

Test set-up photos:



Test site: Bluetooth anechoic shielded chamber (1 – 26 GHz)

In the Bluetooth anechoic chamber the EUT was placed on a non-metallic table, 1,4 m above the floor. The radiated disturbance electric field intensity was measured at a distance of 3 m. The specified test mode was enabled.

An overview sweep with peak detection of the electric field intensity was performed with the spectrum analyser in max-hold and with the antenna placed 1,4 m above the floor. The polarisation was horizontal and vertical. The measurements were repeated with the EUT rotated in 90-degree steps. At the frequencies where high disturbance levels were found a search for max disturbance level was performed. With the EUT and antenna in the worst-case configuration new measurements with average detector were carried out. Test set-up photo is shown below.



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Test set-up photo:

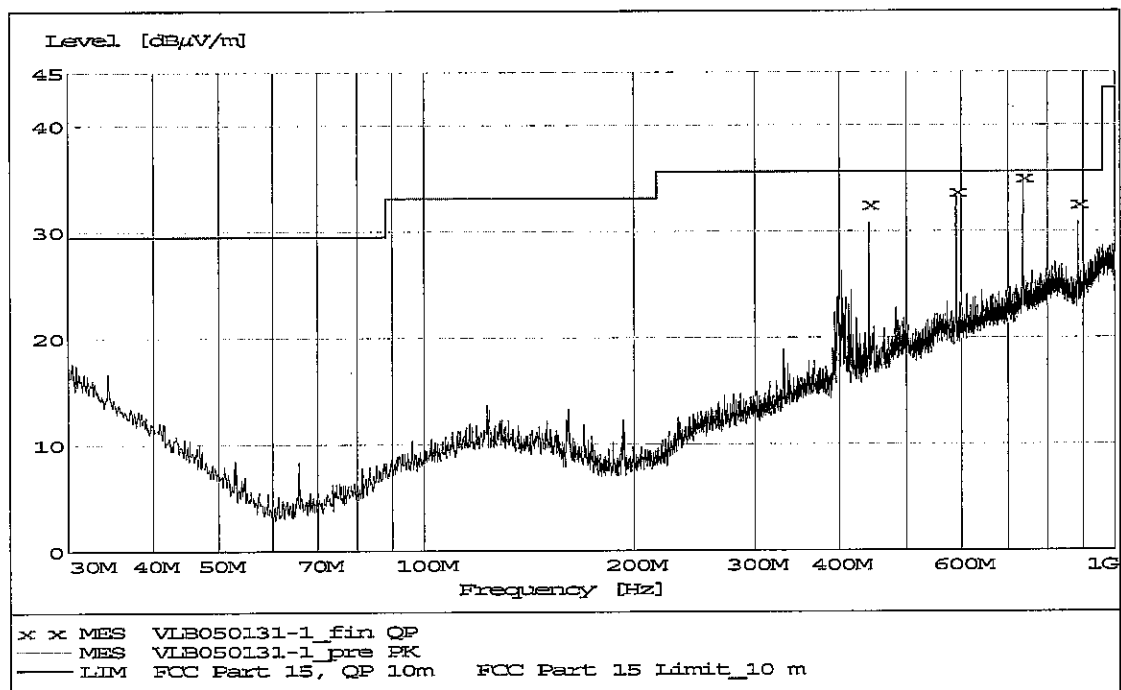


7.5 Test protocol

Semi-anechoic shielded chamber

Date of test: January 31, 2005

30 – 1000 MHz, max peak at a distance of 10 m on the lower TX channel



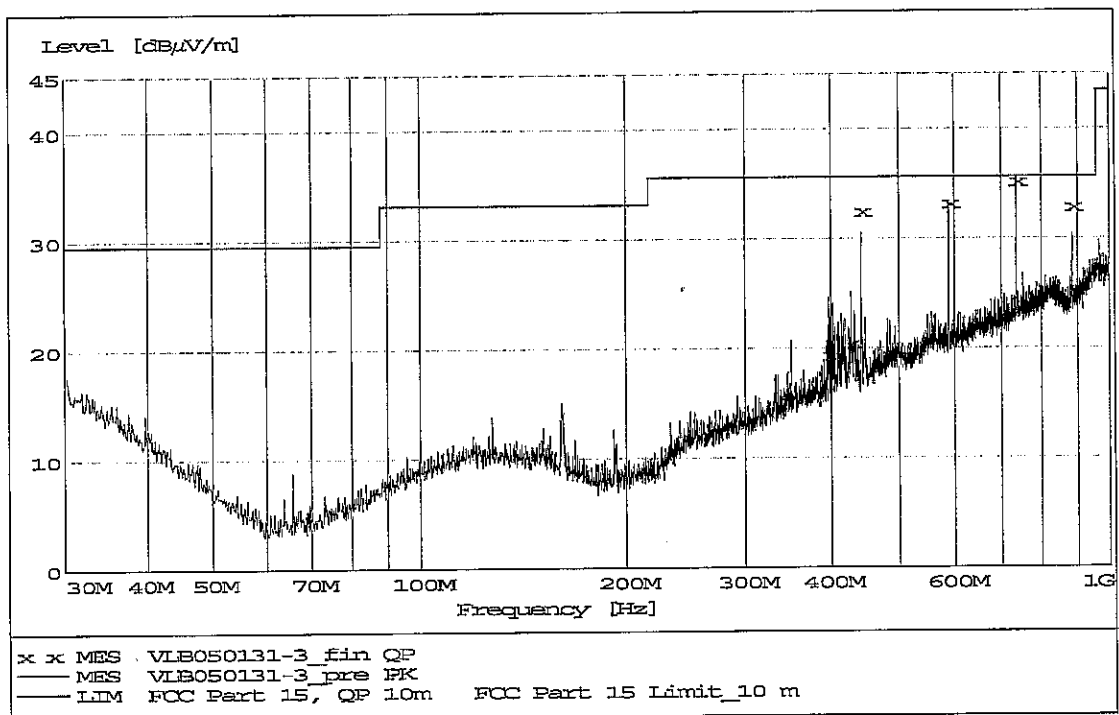
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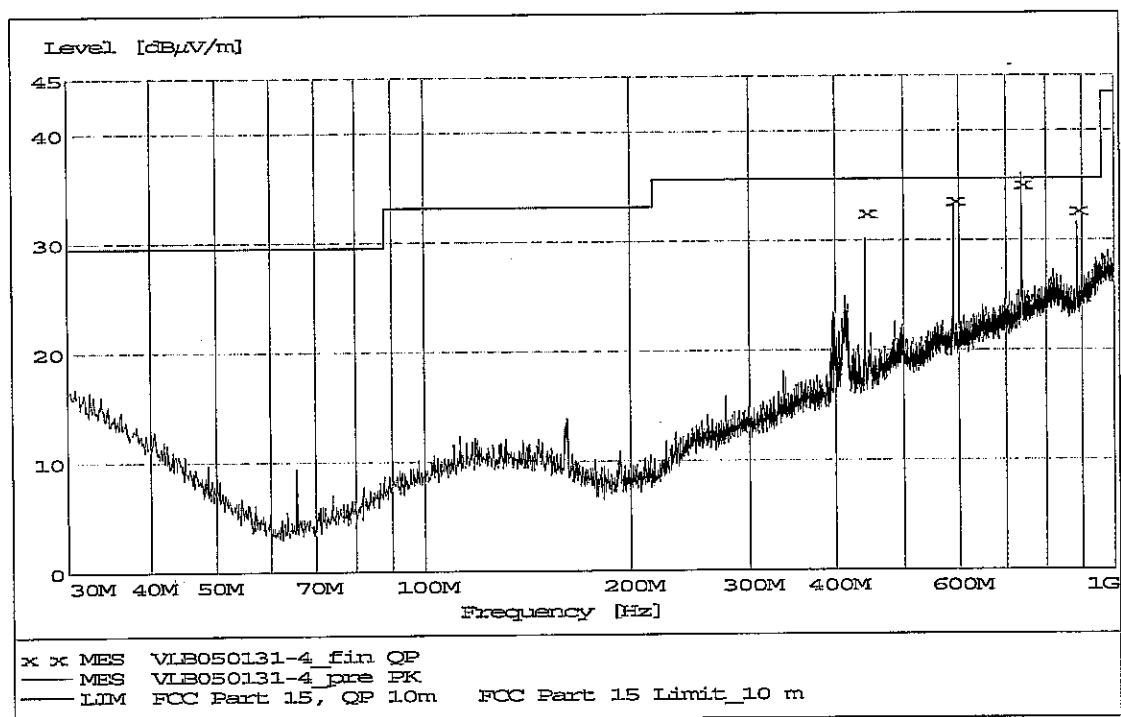
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30 – 1000 MHz, max peak at a distance of 10 m on the middle TX channel



30 – 1000 MHz, max peak at a distance of 10 m on the upper TX channel



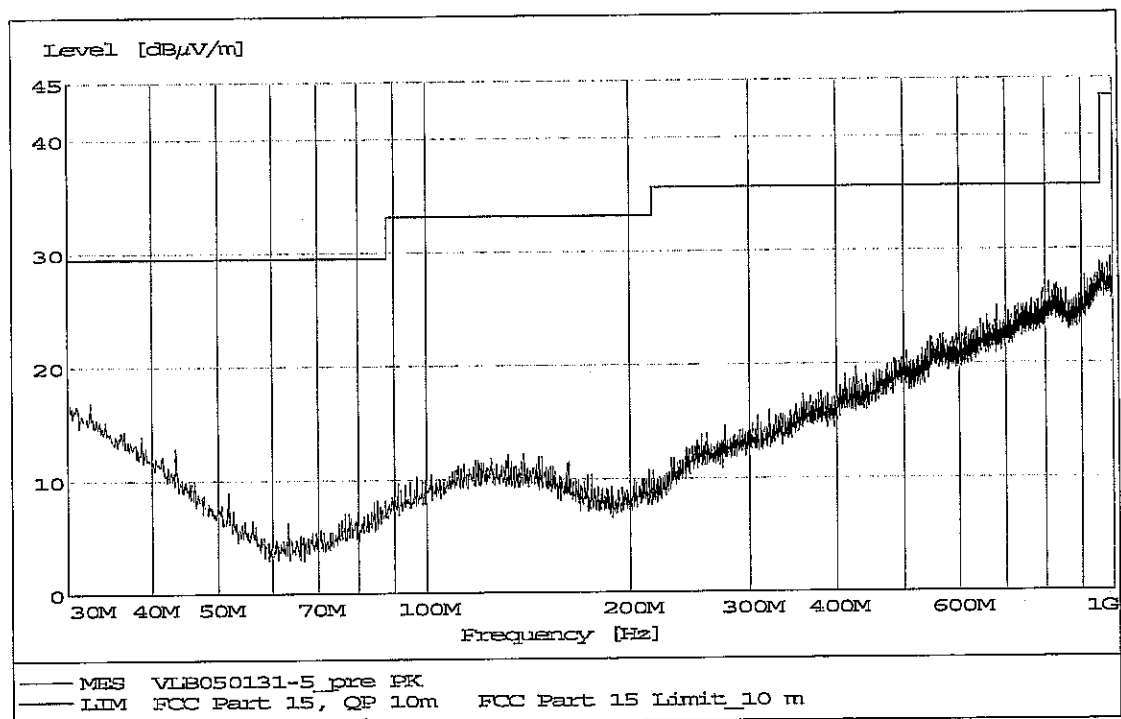
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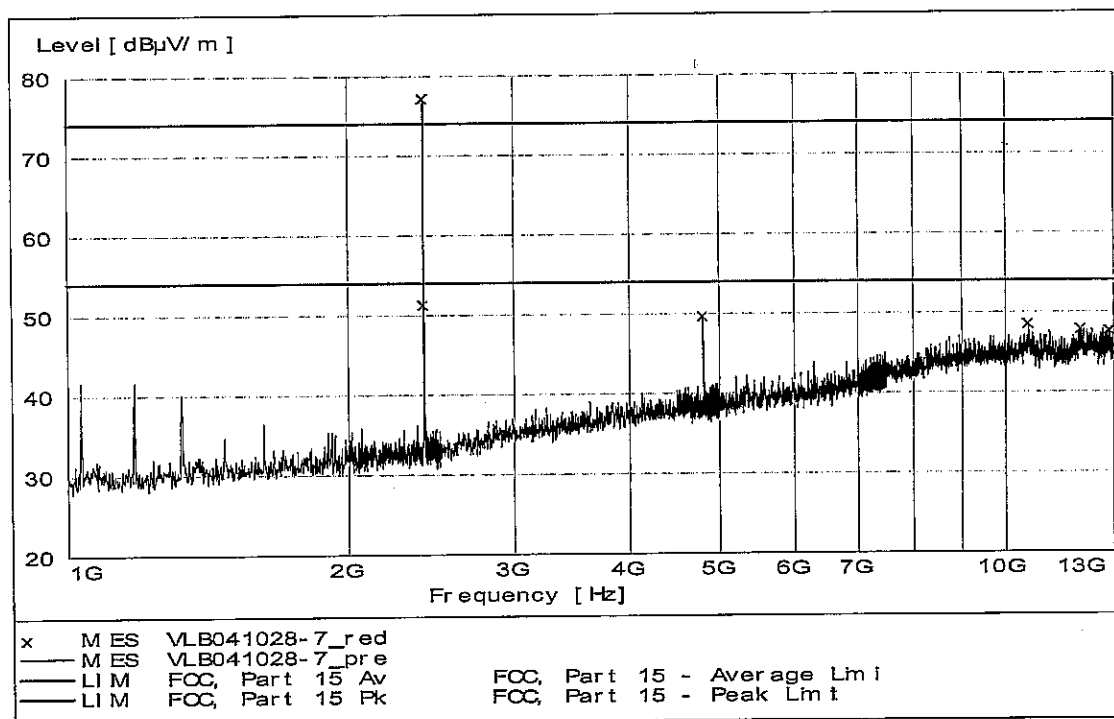
30 – 1000 MHz, max peak at a distance of 10 m in the stand by mode



Bluetooth anechoic shielded chamber

Date of test: October 28, 2004

1000 – 13000 MHz, max peak at a distance of 3 m on the lower TX channel



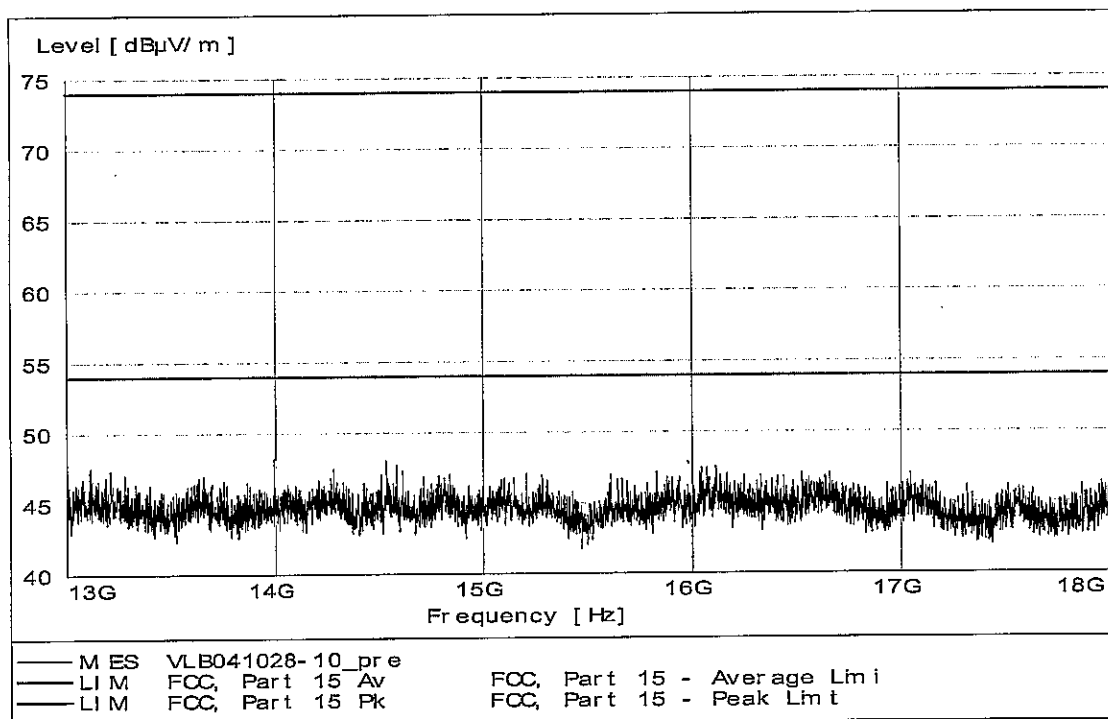
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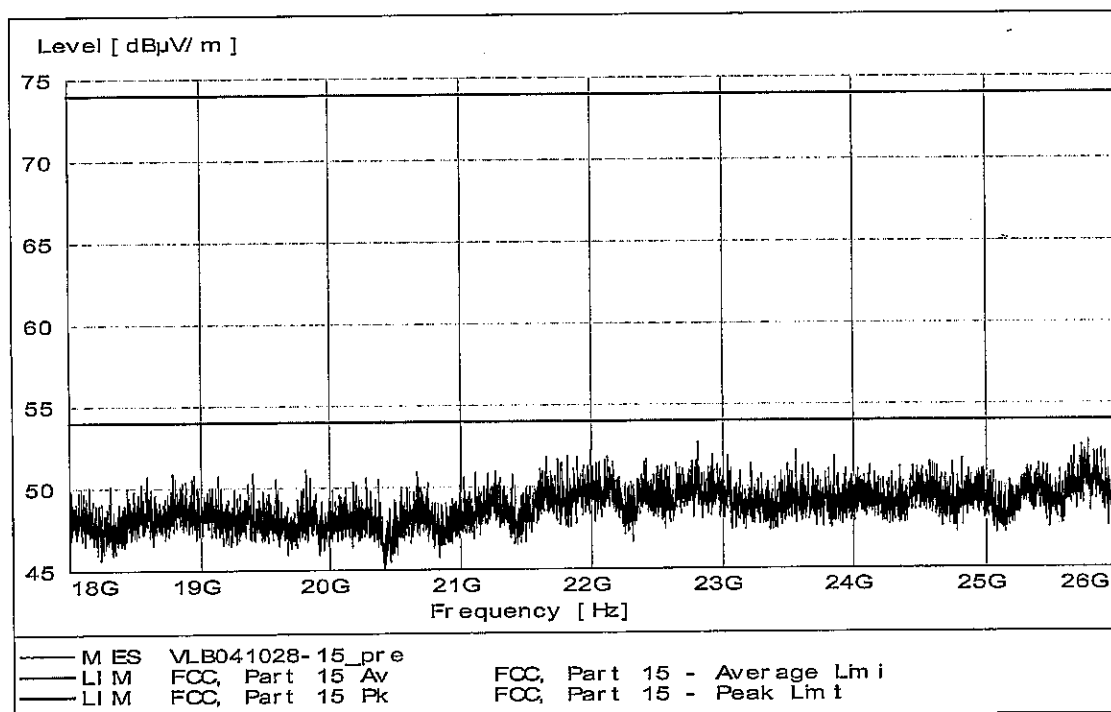
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13000 – 18000 MHz, max peak at a distance of 3 m on the lower TX channel



18000 – 26000 MHz, max peak at a distance of 3 m on the lower TX channel



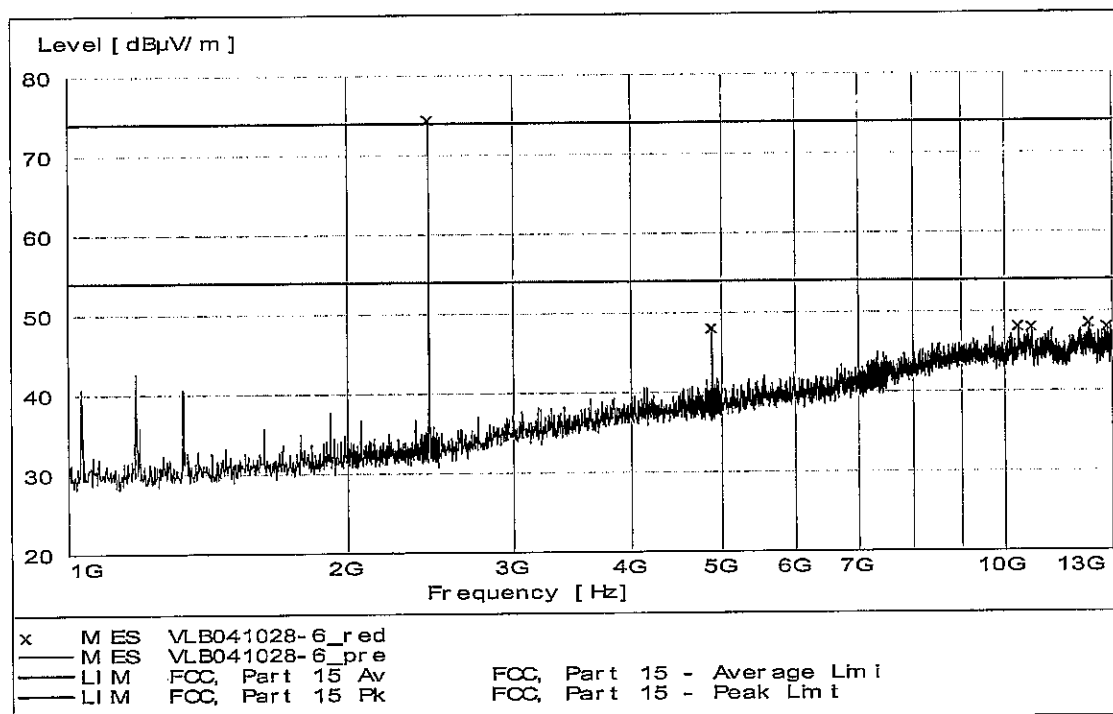
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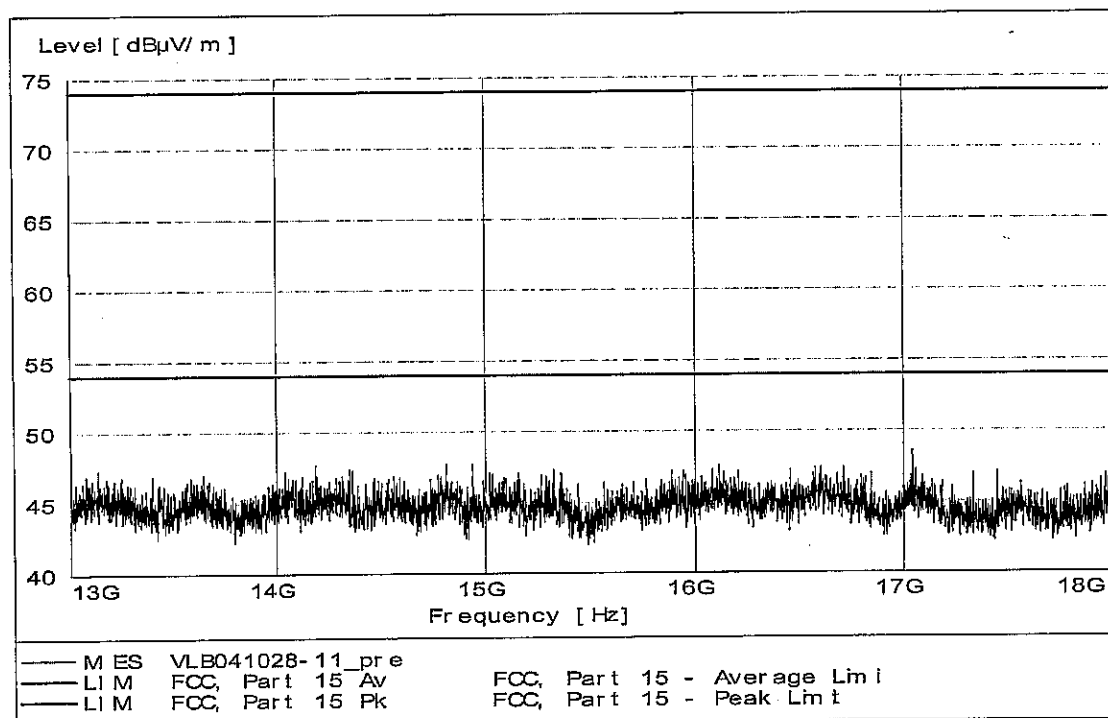
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1000 – 13000 MHz, max peak at a distance of 3 m on the middle TX channel



13000 – 18000 MHz, max peak at a distance of 3 m on the middle TX channel



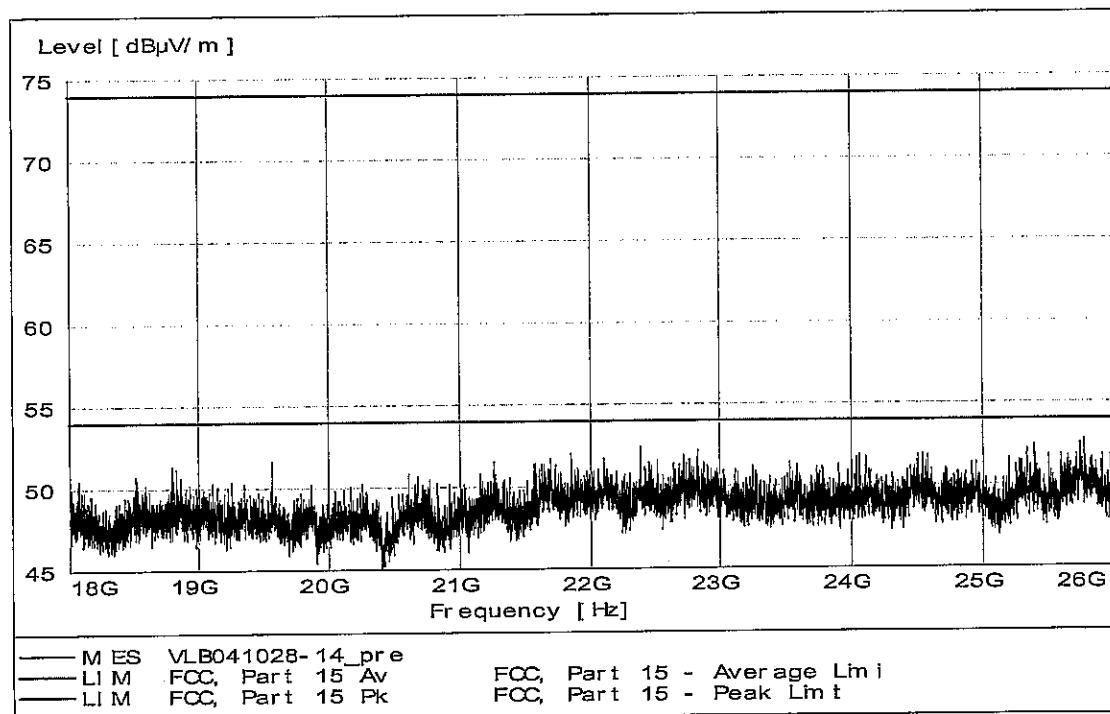
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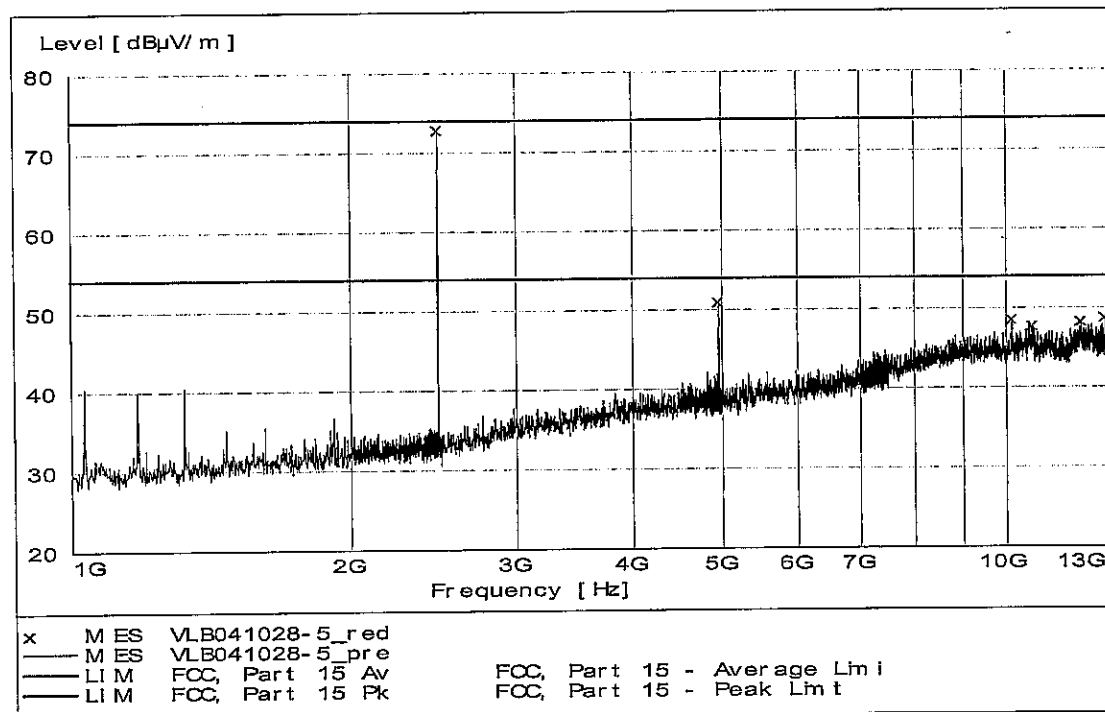
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18000 – 26000 MHz, max peak at a distance of 3 m on the middle TX channel



1000 – 13000 MHz, max peak at a distance of 3 m on the upper TX channel



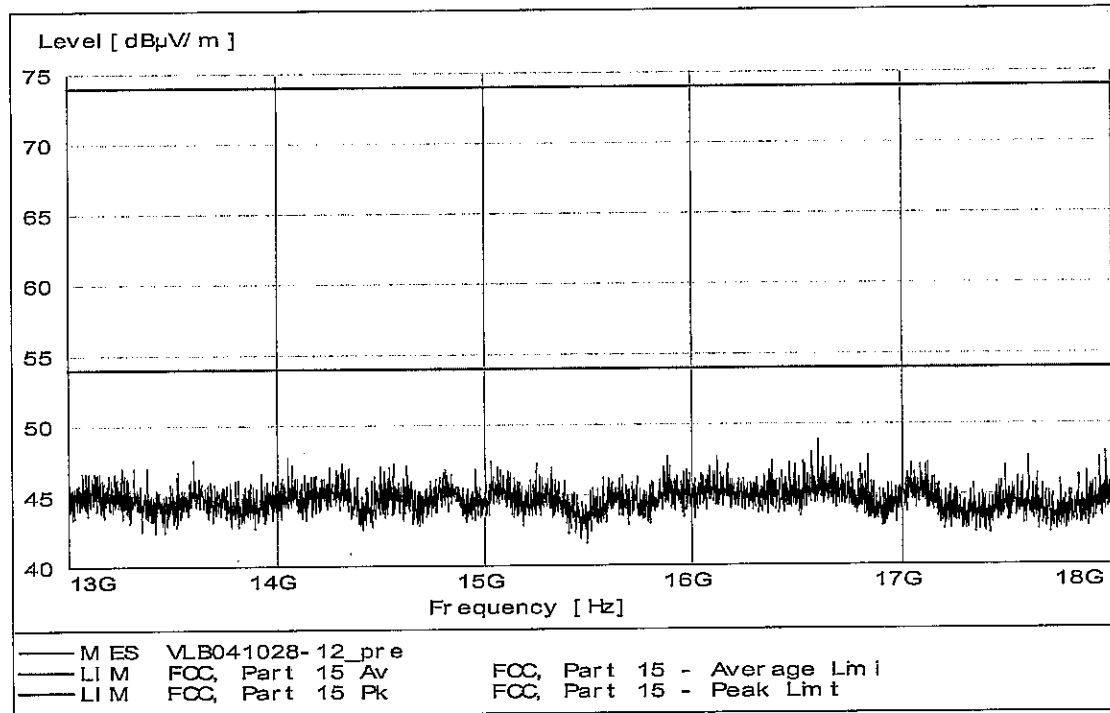
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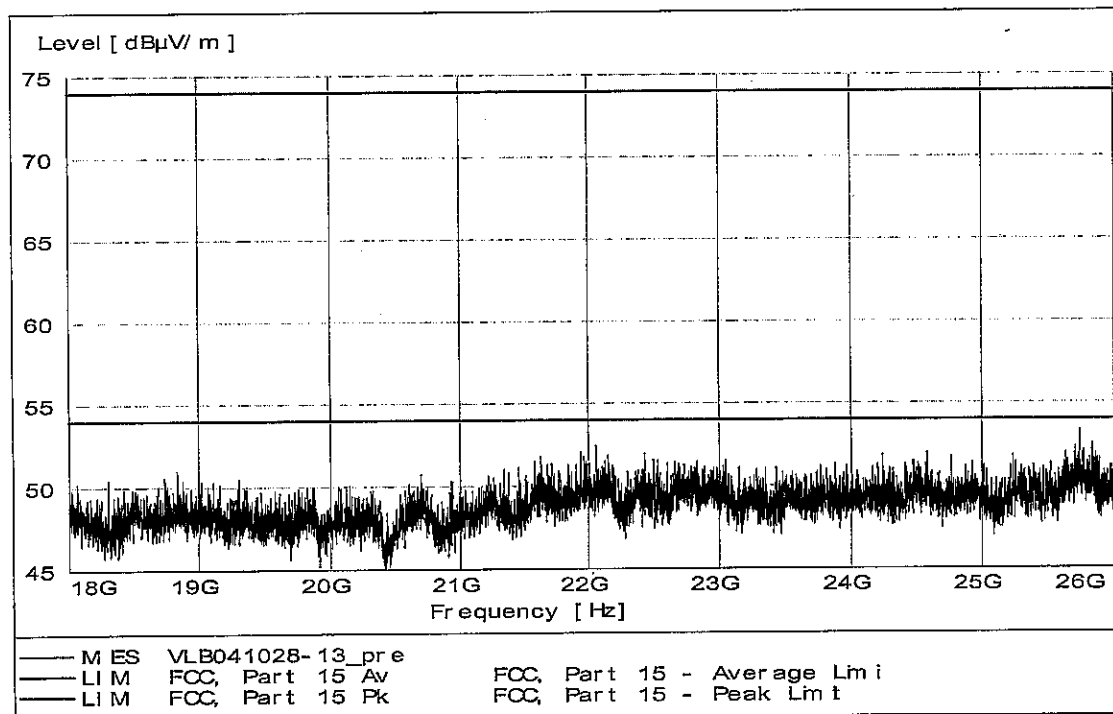
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13000 – 18000 MHz, max peak at a distance of 3 m on the upper TX channel



18000 – 26000 MHz, max peak at a distance of 3 m on the upper TX channel



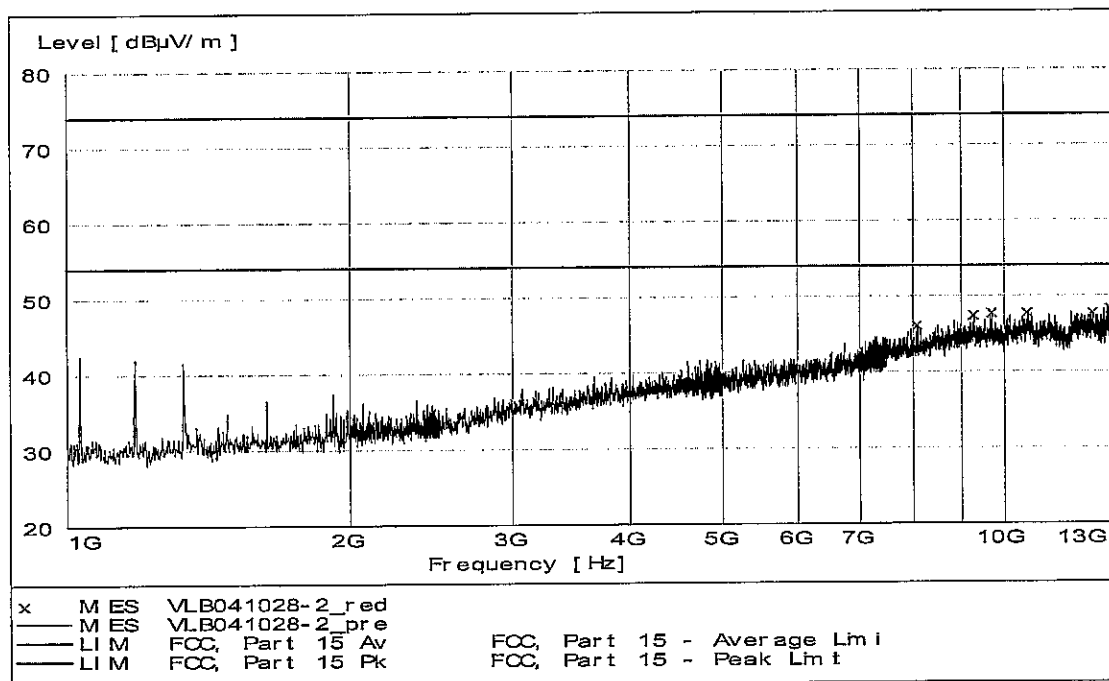
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1000 – 13000 MHz, max peak at a distance of 3 m in the stand by mode



Data summary

Field strength of spurious emissions						
Frequency [MHz]	RBW [kHz]	Measured level		Limit		Note
		Peak [dB(μV/m)]	QP/AV [dB(μV/m)]	Peak [dB(μV/m)]	QP/AV [dB(μV/m)]	
30 – 88	120	<18	-	-	29,5	1)
88 – 216	120	<15	-	-	33	1)
442,4	120		33	-	35,6	1)
589,8	120		34	-	35,6	1), 2)
737,4	120		35	-	35,6	1), 2)
884,8	120		33	-	35,6	1)
960 – 1000	120	<29	-	-	43,5	1)
1032	1000	47	40	74	54	3 m distance
1180	1000	44	36	74	54	"
1326	1000	46	36	74	54	"
4804	1000	52	47	74	54	"
4882	1000	55	45	74	54	"
4960	1000	55	50	74	54	"
13000 – 18000	1000	<48	-	74	54	"
18000 – 26000	1000	<53	-	74	54	"

Notes:

- 1) The measurements were performed at 10 m distance (see Section 7.4, Test set-up). The limit at 10 m test distance was calculated using an inverse linear extrapolation factor 20 dB/decade.
- 2) See Note 1 in Section 4, Test summary.

Example calculation:

Measured level [dBμV/m] = Analyser reading [dBμV] + cable loss [dB] – preamplifier gain [dB] + antenna factor [1/m]

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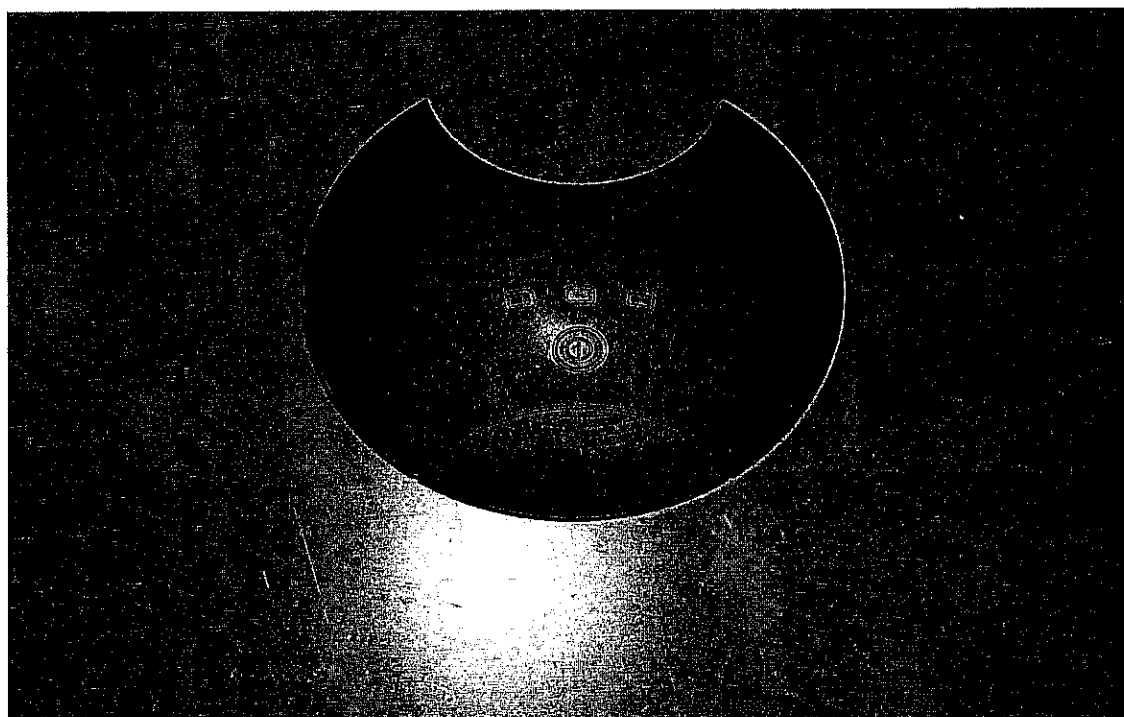
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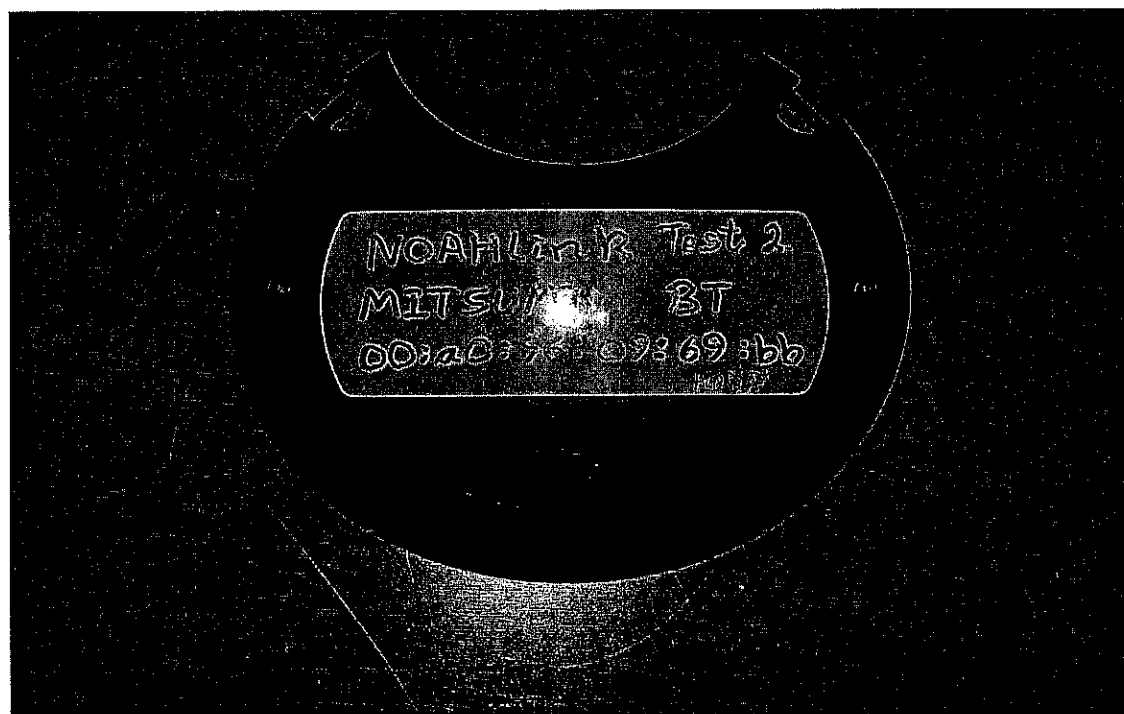


APPENDIX – PHOTOS OF THE EUT

EUT: General view



Identification photo



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